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NOTES ON ECONOMIC GEOGRAPHY.

BY

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HYDROGRAPHY.—Part IV. of the 21st Annual Report of the United States Geological Survey is devoted to this subject. The work is in charge of Mr. F. H. Newell, whose work on Irrigation was lately noticed in the *BULLETIN*. A report on the progress of stream measurements for 1899 occupies 488 pages. The work is widely extended, but the stations for observation are most numerous in the Appalachians and in the arid West. Information is sought in order to facilitate the use of water for power, for irrigation, and for domestic supply. Among New England rivers we find data for the Kennebec, Merrimac, Connecticut, and others, while the Hudson, Mohawk, and Croton receive attention in New York. In all cases diagrams are employed to show the amount of discharge for all the months of the year, and variations within each month are shown in some detail. A good feature is the large number of hydrographic maps showing drainage of single basins, free from other and confusing detail. Such a map of the Croton basin, with its streams and reservoirs, appears on page 74. The upper Hudson is shown on page 71, and the Mohawk on page 64. The Illinois and its branches, grasping the country about the head of Lake Michigan, make a striking map, and this, like others in the report, is most valuable material for the teacher of geography. Nor should we overlook the large number of good photographs which have been reproduced to illustrate various phases of the subject. The figures include also many contoured maps of reservoir sites. The second paper in the volume is by Mr. N. H. Dorton, and relates to the Black Hills and surrounding country. A somewhat full description of the topography and geology is preparatory to an account of the water and other resources. The Hills are due to a central uplift, exposing a core of old rocks, while the younger formations dip away in all directions, and pass beneath the plains. Some of these are sandstones. Their exposure in the Hills, and their dip, which becomes less away from the centre of uplift, furnish artesian conditions which are described in detail for the several formations. The streams of the region furnish a con-

siderable surface supply for irrigation, and this could be increased by building suitable reservoirs.

Coal is the chief mineral of the sedimentary rocks of the region, and there are also found petroleum, gypsum, grindstone, and fuller's earth, with some promise of limestone suitable for lithographic work. A short account is given of the climate and the forests.

The volume concludes with an interesting paper by Mr. Willard D. Johnson, entitled "The High Plains and their Utilization," pp. 601-741. From the point of view of climate, the region is the sub-humid belt of Nebraska, Kansas, Texas, and New Mexico. Speaking in terms of physiography, the High Plains are the unsculptured remnants of the Great Plains. They are elevated and smooth grounds, with a dry climate erosion belt on the west, and a humid erosion belt, the prairies, on the east. They front the prairies by an easterly-facing escarpment, which led to their being called the High Plains.

In origin they are undestroyed parts of the *débris* slopes of the Rocky Mountains, and as land-forms are characteristic of an arid region. Streams from the mountains have wandered freely over these vast surfaces and made them what they are. These stream beds lie on a foundation of marine beds which have been tilted gently to the east and veneered with an alluvial cover. This cover sometimes attains a thickness of 500 feet. The smooth surface is preserved by the sod, while the bunch grass on the arid plains nearer the mountains gives no protection from erosion by rains and small streams. It is thus seen that Mr. Johnson rejects the widely-accepted lacustrine theory for the origin of these beds, about which in recent years there has been a growing scepticism. In particular, the frequent coarseness of the beds argues for their alluvial origin.

As distinguished from the still drier region on the west, the Plains became known as the rain belt, thus leading to several years of disastrous agricultural experiment. In the decade from 1885 to 1895 there was a rush into this territory, under the impression that crops could be raised without irrigation. This belief was strengthened by several seasons of exceptional rainfall, and it was thought that the climate was changing. But daily records of twenty-five years in some localities dispose of this view. Dry years are sure to follow the wet ones, and compensation cannot be had in the humid times for the losses of the dry periods.

We have here not so much a deficiency of rain as an excess of evaporation. The amount of rain is not the only factor in agricul-

ture. The Staked Plains have as much rainfall as the Dakota wheat lands, but are in effect much drier on account of the spasmodic character of the rains, greater evaporation, and lower relative humidity. The author gives graphic descriptions and some photographic illustrations of abandoned roads and town sites.

Irrigation is therefore essential to agriculture in this region, and this in turn is possible in but slight measure. The water cannot be had. Seepage and evaporation render storage impracticable. The streams from the mountains are not great rivers like the Nile or the Indian rivers which descend from the Himalayas. It is better economy to use the waters of the Arkansas river, for example, nearer the mountains, where the loss is less, and where better reservoir sites exist. Thus irrigation at Garden, Kansas, became impracticable because of increasing abstraction of the water in Colorado. The Canadian and Pecos rivers are not available for the Staked Plains. A very limited supply of water may be had from artesian wells, as in the case of the Meade Artesian Basin in Kansas, where there are several flowing wells; but these conditions are rare. A number of interesting small basins are due to ground settlement, and vary from the size of a buffalo wallow to a diameter of 1,000 yards or more. The author notes an interesting dependence on natural conditions for building materials. On the prairies the pioneer built of logs. In the "short grass" country—that is, on the High Plains—he uses sod, and in the arid belt, or "bunch grass" country, he must have recourse to "adobe," or sun-dried mud.

MINERAL RESOURCES OF THE PHILIPPINE ISLANDS.—Part III. of the 21st Annual Report of the United States Geological Survey contains (pp. 487–625) a paper by George F. Becker on the Geology of the Philippine Islands. Mr. Becker spent fourteen months in the Archipelago, but was much hampered by the attitude of the natives and by the necessity of working under the protection of a military escort. He records his own observations, and seeks to compile all that is known of the geology of the region, chiefly from the researches of Spanish, German, and Austrian geologists. Pages 594–605 contain a bibliography of more than one hundred titles, with brief annotation. Mr. Becker gives an interesting notice of the volcanoes of the Philippines, stating that a considerable number have been active since the first occupation by the Spaniards. Mount Apo is the highest summit in the group, having an altitude of between ten and eleven thousand feet, the determinations not being in agreement. The cone is described as covered with sulphur above

7,500 feet. Solfataras and hot springs abound in certain localities. No pre-tertiary strata are known in the islands. A splendid series of marine terraces is seen about the Island of Cebú.

Black lignite is considered the most valuable mineral asset of the Philippines, and it occurs widely from southern Luzón southward. There are three of the more important known gold fields. A Spanish observer is quoted for the statement that "gold is found in moderate quantities nearly all over the Island of Luzón." In the Province of Lepanto both vein and placer gold occur. Among native miners "the Igorrotes are gifted with mechanical skill, and are not afraid of solid rock." For crushing, the natives have devised a kind of trip-hammer by attaching a heavy stone to a sapling. The only important known copper deposits are in the Province of Lepanto, where the veins have been worked by the Igorrotes. Brief notices of lead and iron are given, including a belt of magnetite in the mountains of Luzón. Petroleum occurs, but has been exploited little, if at all. The volcanoes will furnish large supplies of sulphur.

"The Coal Measures of the Philippines" is a report prepared by Charles H. Burritt, and transmitted to the Military Governor of the Islands. It is published by the War Department (269 pp). The report is largely historical, and an exposition, through numerous documents reproduced, of the slovenly and ineffective operations carried on under Spanish administration. Coal was first found in the Philippines in 1827, but the mining industry has its real beginning in 1853. Some Spanish observers began to see the value of the coal, and to urge that its proper development would bring increase of wealth, the growth of commerce, and habits of industry on the part of the natives. The best deposits are in Southern Luzón, where beds occur which are nearly 15 feet in thickness.

AGRICULTURAL RESOURCES OF HAWAII.—This is the subject of Bulletin No. 95, Office of Experiment Stations, U. S. Department of Agriculture. The author is Dr. Wm. C. Stubbs, director of the Louisiana Agricultural Experiment Stations. The extension of experiment work, the promotion of more varied agriculture and irrigation, are some of the special objects of the investigation. Sugar now furnishes more than 80 per cent. of the total exports. Coffee-growing is diminishing, and rice is not grown on approved modern methods. Dairying is unknown, and many forest areas have suffered unfortunate denudation. Irrigation methods are often expensive and wasteful.

The report opens with a convenient summary geographical

account of the islands, including the origin of the people, the geology, soils, climate, and rainfall. The fertile belts are near the ocean, and even these must, in many cases, be irrigated. The rainfall is exceedingly variable. On the windward or eastern side of Hawaii are points where the rainfall attains 300 inches. On the lee side, for 50 miles along the coast line, the rainfall amounts to about 4 inches per year. Such extremes may even occur within a few miles of each other. The flora is described as peculiar, "containing a larger proportion of endemic plants than any other known country." Excluding species introduced since Captain Cook's discovery of the islands, there remain 860 original species. Among plants of economic importance are many woods and fibre plants, some of the woods having great hardness and durability. The seedless breadfruit, the sugar cane, and the banana all reached the islands by human agency. Coffee flourishes, but is less extensively cultivated, owing to the greater profits of sugar production.

The water used in irrigation is often pumped from great depths. The coal is high in price, and watering is thus costly. In spite of this, over-watering is common to the injury of crops and of the soil itself. There are some artesian basins, as at Honolulu, where the water-bearing beds are about 500 feet below the surface. The trade in woods and the grazing of herds of domestic animals have led to an unhappy destruction of forests. Honolulu has made large expenditure in re-clothing with trees some of the adjacent mountain slopes. Re-forestation must, it is believed, be carried on systematically by the Government of the Territory. The problems of labour and the land laws also receive discussion. A number of maps are included, and the photographic illustration is good. Many views of fruits and trees are exceptionally fine. It is not often that reports of this nature contain so much interesting geographical material.

SOIL SURVEY OF THE UNITED STATES.—This work is carried on by the Division of Soils, United States Department of Agriculture. Professor Milton Whitney is the Chief of the Division, which has been recently established, and has just issued its second report (*Field Operations of the Division of Soils, 1900*). The report comprises a volume of 473 pages, accompanied by 24 maps in case. The object of this survey is to classify and map the soils of the United States, with such reference to climate, economic conditions, and special crops as to make the work of practical value to agriculture. The

Division is organized for work both on the east and the west of the Mississippi river, and also carries on a laboratory of soil physics and soil chemistry. In 1900, 4,460 square miles were surveyed at an average cost of \$1.97 per square mile; and 17,000 copies of the report were printed, and the call for them has been active. Operations were carried on in 1900 in Arizona, California, Connecticut, Maryland, Massachusetts, New Mexico, North Carolina, Ohio, Pennsylvania, and Utah. The effort is made to co-operate with State surveys and experiment stations, thus serving local interests and securing unity. Following the report of the chief are reports on the several districts surveyed. These special chapters describe the local soil types, with notes upon their origin and use. Introductory studies of topography and geology are given, and there are commonly notices of climate, transportation facilities, of the social, industrial, and historical conditions.

The fundamental factor of soil differences is often neglected by the farmer, who is thus led to unprofitable labour. It is a chief object of the Soil Survey to discriminate the capabilities of soils and make available to all the results of experience, and thus lessen the sum of wasteful effort. It may be added that the reports on areas in Utah, Arizona, and California discuss questions of water supply, application of water, and the treatment of alkali soils.

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